

Tether Physics & Survivability



NRL's Naval Center for Space Technology has designed, built, and deployed the Tether Physics & Survivability (TiPS), a two-part satellite system to research the gravity-gradient dynamics and survivability of a tethered system in space. TiPS was deployed on June 20, 1996 and is still currently intact.

A deployment sequence jettisoned the TiPS from a host vehicle and then separated the end masses from each other. When fully deployed the 53.5 kg (118 lb) mated tethered system consists of two small end masses connected by a 4 km (2.5 miles) non-conductive braided tether. The TiPS endmasses are similar in size and weight, which dictates that both undergo significant motion with respect to the center of mass of the system. The heaviest end mass, affectionately dubbed "Ralph" weighs 37.7 kg (83.2 lb). Ralph contains all of the electronic components, which include the telemetry system, turn count recorder, and temperature sensors. The lighter end mass dubbed "Norton" weighs 10.3 (22.8 lb). The tether weighs 5.5 kg (12.0 lb.), and was coiled on a spool inside Ralph, much like a spinning reel. Ralph and Norton separated at a relative velocity of approximately 5.1 m/s (16.7 ft/s). The initial separation energy was designed to deploy about 2 km of the tether, at which time gravity-gradient forces assisted to unwind the remainder.

Tethered systems are a new and relatively untested space technology. The TiPS spacecraft is designed to characterize tether dynamics and survivability in the space environment. Specific dynamics issues of tethered systems include libration amplitudes and stability, while tether issues include internal damping and flexibility. From a survivability aspect, TiPS' tether is susceptible to space debris. The tether, roughly 2 mm in diameter, can be severed by a 1 mm size particle with a relative velocity of 14 km/s (31,318 mph).

The TiPS experiment has yielded data about tethered space systems. The TiPS tether is the sixth known tether system flown and is the longest surviving space tether.

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